DOCUMENT RESUME

ED 144 787 SE 022 923

TITLE	Suggested Activities for Environmental Education in the Secondary Schools.
INSTITUTION	Texas Education Agency, Austin. Div. of Curriculum Development.
PUB DATE	77
NOTE	47p.; For related document, see SE 022 922; Not available in hard copy due to colored print throughout entire document
EDRS PRICE	MF-$0.83 Plus Postage. HC Not Available from EDRS.
DESCRIPTORS	*Classroom Materials; Curriculum Enrichment; *Curriculum Guides; *Environmental Education; *Instructional Materials; Learning Activities; Resource Materials; Science Education; *Secondary Education
IDENTIFIERS	Texas Education Agency

ABSTRACT

This publication is designed as a model to assist middle school and high school teachers in developing environmental education activities in all subject areas. Both public school and college educators developed this guide to help make young people aware of the value of the environment and of the responsibility they have for conserving it. Discussions of the curriculum model for the guide and the program format and criteria are included for the teacher. The curriculum model demonstrates the interrelationships of personal concerns, environmental concerns, and educational process. A multidisciplinary approach is an important component in every suggested activity topic. Some of the areas covered are environmental ethics, government and law, land use, pollution, population, energy, and economics. Each topic includes a short overview and a listing of generalizations and suggested pupil activities. The educational experiences and activities are designed to individualize student learning, emphasize community involvement, and encourage exploratory and investigative learning. A companion guide is also available for elementary grades. (Author/MA)

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Suggested Activities for Environmental Education in the Secondary Schools

SE 022 923

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Texas Education Agency
Division of Curriculum Development

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FOREWORD

Environmental Education in the Secondary School: Suggested Activities is designed as a model to assist middle school and high school teachers in developing environmental education activities in all subject areas.

This publication and a companion, *Environmental Education in the Elementary School: Suggested Activities*, publication number CU7 832 02, were developed by public school and college educators.

We hope this guide will help to make young people aware of the value of the environment and of the responsibility they have for conserving it.

M. L. Brockette

M. L. Brockette
Commissioner of Education

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OTHER RESOURCES

Appreciation is extended to Jacque Miller, School of Education, Morningside College, Sioux City, Iowa

Appreciation is extended to the Division of Technical and Environmental Education, U.S. Office of Education, for permission to incorporate portions of the guide *How to Initiate an Environmental Program.*

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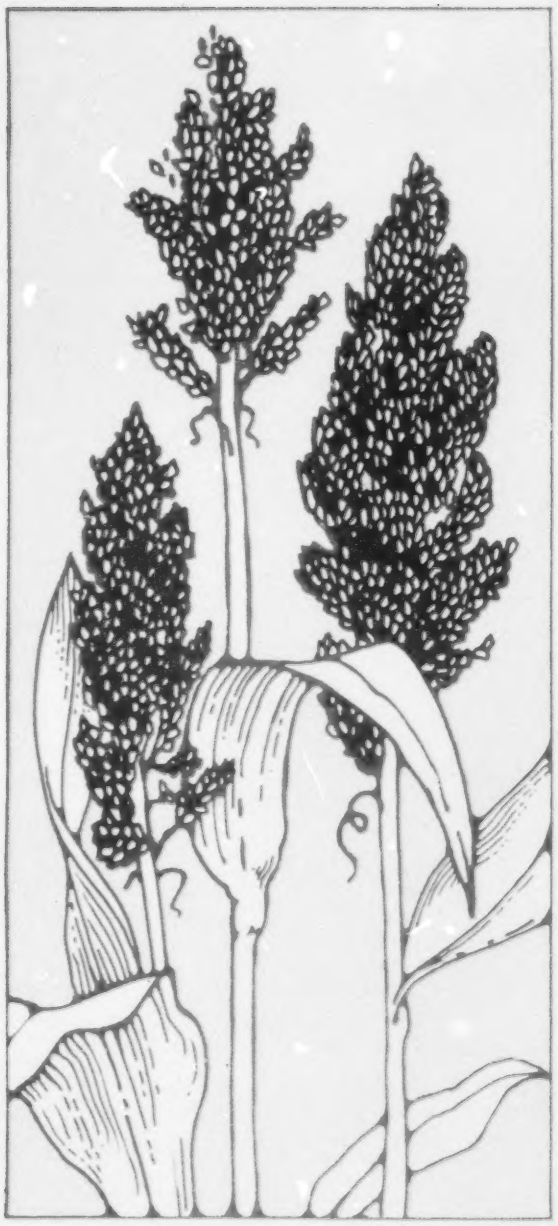
INTRODUCTION



Within the past two generations, Texas' population has more than doubled and has dramatically changed from rural to urban. As a result of these changes, citizens have greatly altered their surroundings thus creating many environmental problems. Pollution of the environment, unplanned land development, and the struggle of plants and animals to survive are but some of the pressing problems humans have created.

Each citizen's attitude toward the management of the earth's resources will eventually determine the quality of life which can be expected. Direct experiences with a wide spectrum of resources will prepare individuals to cope with the problems of the environment. These experiences are absolutely essential to shaping constructive attitudes. One cannot really learn from books about conservation of resources. Positive attitudes toward the wise use of resources and the avoidance of excessive pollution will develop through direct involvement with management practices. Strategies must be developed to provide real experiences for students in their daily educational activities.

These environmental activities must be multidisciplinary and must be structured around real objects and events in the community which young people encounter in everyday living. Conservation can then become a part of life rather than merely a preparation for the "good life." Every facet of human concern must be a basis for designing educational experiences for pupils.

Teachers and administrators of Texas public schools have expressed the need for a resource guide to aid in the development of environmental education experiences throughout the curriculum, kindergarten through the twelfth grade. This guide for secondary administrators and teachers represents an effort to meet part of that expressed need. It provides for students in grades 7-12 an array of direct involvement activities which are based upon human concerns ranging from personal and economic security to consumer behavior and career activities. Minimum emphasis is placed upon listening and maximum emphasis is placed upon action.

CURRICULUM MODEL FOR THIS GUIDE

The student activities and outcomes contained in this guide are based upon a three-dimensional model which emphasizes:

(1) Personal concerns of people
(2) Problems of environmental quality
(3) Learning functions of students

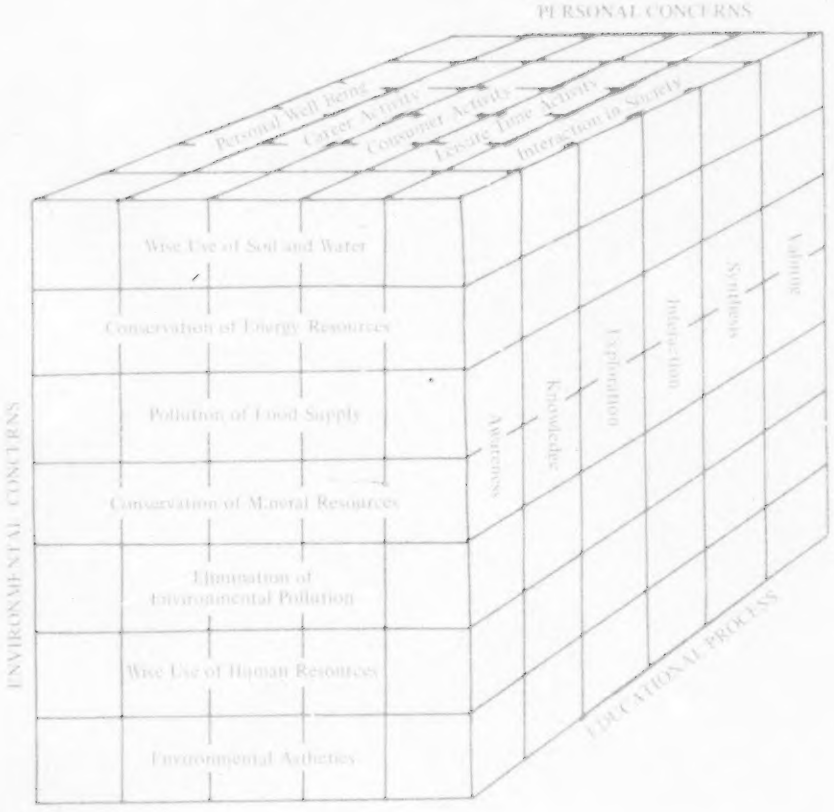
The model below demonstrates the interrelationship of these basic factors. For example, a learning activity can be constructed around the first cube in the model (upper left corner) which demonstrates the intersection of Personal Well-being, The Use of Soil and Water, and Awareness Level of Educational Process. The learning activity, therefore, would center on how an awareness of wise soil and water conservation practices can affect the personal well-being of each individual.

The following model illustrates the interaction of these three dimensions.

The intersection of the three dimensions of the cube model — environmental concerns, personal concerns, and educational processes — provides the 210 program cubes which serve as a base for curriculum building.

As illustrated in this model, all people, regardless of age, economic status, or field of work, have the same basic concerns. Each person is most directly concerned with personal health and well-being. To live the "good life," one must be free of chronic illness and have a healthy and positive self-image. By the same token, everyone should be interested in a productive and satisfying career. People who view their jobs as interesting, productive, and economically satisfying have a greater chance for personal happiness. In these days of rising prices and shortages, an increasing amount of attention is being focused upon consumer affairs. People are concerned with getting their money's worth and not being overcharged for goods and services.

Recent technological advances which provide



citizens with more leisure time have focused increased attention on the productive and satisfying use of leisure time. As the recreational industry grows, so does the need for wise utilization of resources for recreation in our state and nation. In addition to the personal concerns for well-being, career choice, consumer activities, and recreation, an increase in population has brought about the need for living in greater harmony with society. People-to-people problems have become more acute as evidenced by a rise in certain crime and by increased questioning of credibility of politicians and individual citizens.

The second dimension of environmental education is directly related to the immediate and long-range problems in the environment. The daily newspaper provides ample evidence that our nation must increasingly deal with environmental problems related to energy reserves, food supplies, and pollution. Basically, the environmental problems addressed in this guide relate to the following:

- The Wise Use of Soil and Water
- Conservation of Energy Resources
- Pollution of Food Supply
- Conservation of Mineral Resources
- Elimination of Environmental Pollution
- Wise Use of Human Resources
- Environmental Aesthetics

In looking at the three-dimensional model on page 7 one can see that each of the areas of human concern can be related easily to the individual's use or abuse of the resources which this earth provides. For example, personal well-being is directly related to an adequate supply of wood and water and to the wise use of our soil resources. Numerous careers are based upon the conservation and proper utilization of soil and water. By the same token, there is a direct interaction between such personal concerns as career and leisure time activities and the problems which excessive environmental pollution produces. In summary, it is not difficult to see the close relationship among the five areas of personal concern and the seven areas of environmental concern.

The third dimension of the curriculum model upon which this guide is based is that of individual learning processes. Each educational activity begins with a level of awareness. A successive series of steps, through knowledge and exploration, helps the students develop a value system. Valuing, of course, represents the highest level of educational processes. The educational functions which represent the third dimension of this model include the following:

- Awareness
- Knowledge
- Exploration
- Interaction
- Synthesis
- Valuing

Putting all three dimensions together (for example, awareness of the need for wise use of soil, water, plants; conservation of energy resources, food supply, mineral resources; and elimination of environmental pollution) helps to promote personal well-being.

It is suggested that the teacher refer to the three-dimensional curriculum model presented earlier and go through the mental process of interrelating any one or more of the concerns expressed within the three dimensions. This background activity is designed to provide direct, useful classroom learning experiences for children.

PROGRAM FORMAT

A resource guide, to be useful, must have a simple format along with explicit instructions for classroom utilization. In this guide, each program module is divided into three main sections:

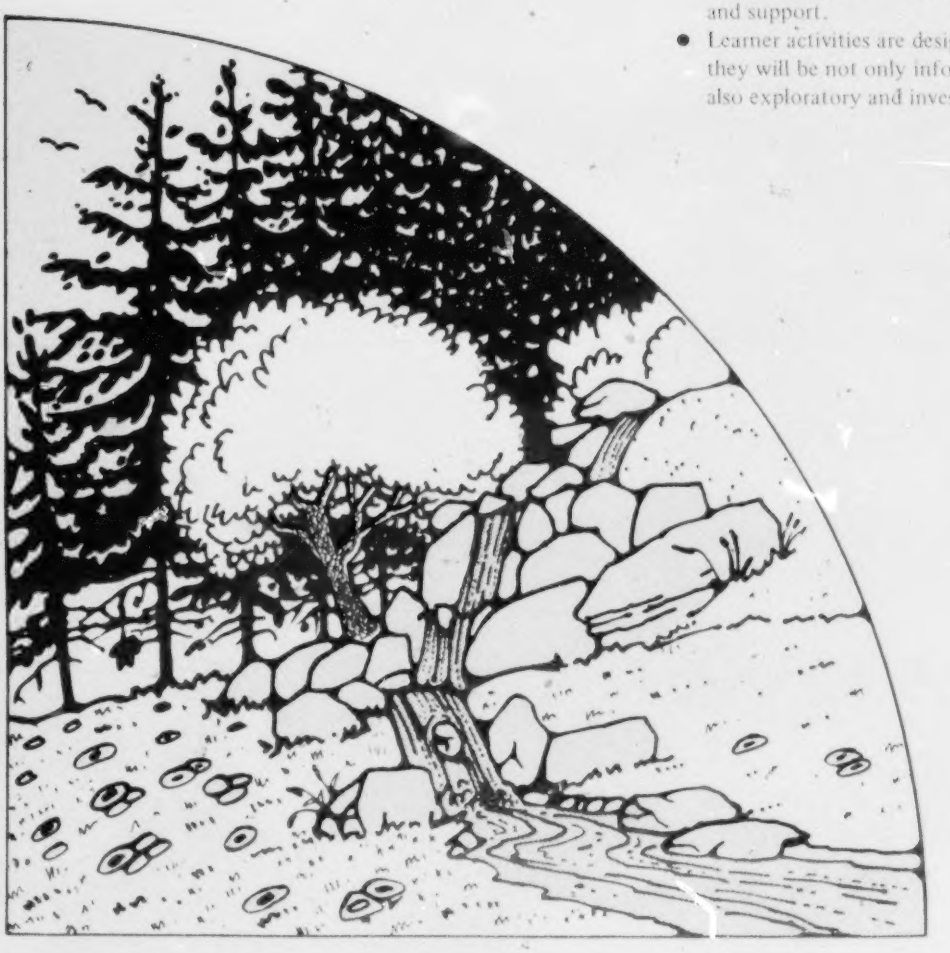
1. An overview and discussion for the teacher, which provides background information and additional teaching resources
2. A statement of generalization to be developed including its relationship to the content area and its interrelatedness to environmental problems, personal concerns, and level of educational activities
3. Suggested student activities for use by individuals or small groups working on their own to investigate and assemble knowledge and ideas

This guide is designed for the secondary school level.

PROGRAM CRITERIA

All the educational experiences and activities contained in this guide have been designed with the following quality control criteria in mind:

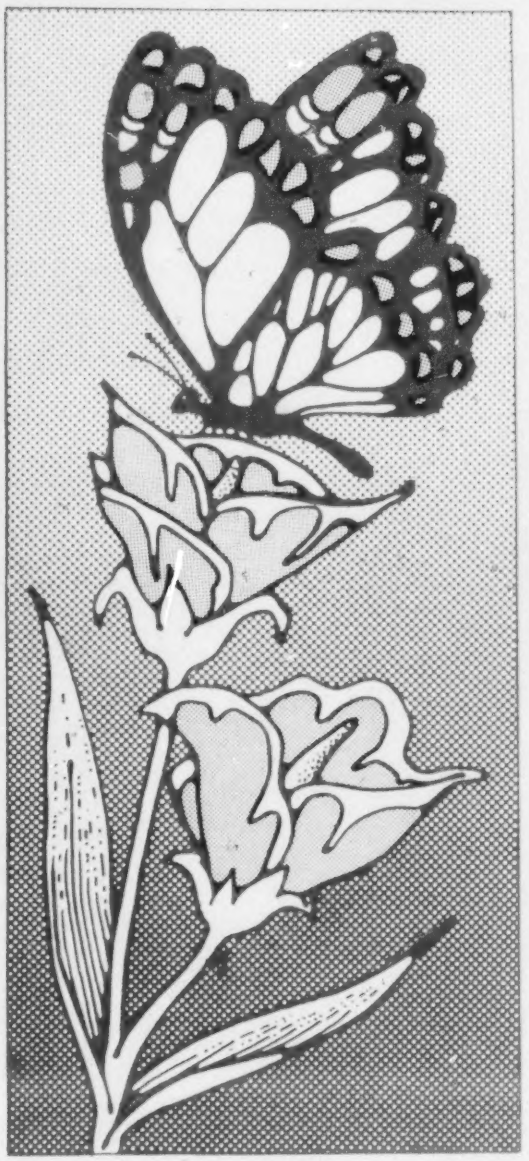
- Each learner activity is derived from an interaction of personal concern about environmental problems with a learning process, such as observing, predicting, or analyzing.
- Each learner activity is individualized so that the learner assumes the primary role in investigating and finding answers.
- All learner activities are designed so that readily available resources can be used.
- Emphasis in each learner activity is placed upon community involvement and support.
- Learner activities are designed so that they will be not only informative but also exploratory and investigative.



ENVIRONMENTAL ETHICS

OVERVIEW

All inhabitants must share the bounty of the planet earth with all its present inhabitants and preserve it for future generations. Environmental ethics is respect for the needs of all living things and a self-commitment to use all resources wisely.



GENERALIZATION AND SUGGESTED STUDENT ACTIVITIES

1. **The environmental ethic is derived from a continuous process of examination of all available information.**
   - 1.1 Write a poem to define *environmental ethic.*
   - 1.2 Describe examples of "trade-offs" of certain economic/political situations in the local area.
   - 1.3 Visit a grocery store; list the contents and cost of convenience foods, and evaluate effects of consumer and convenience orientation on environmental ethics.
   - 1.4 Write a Declaration of Environmental Interdependence or an Environmental Bill of Rights. Submit it to the school newspaper or use it as part of an exhibit.
   - 1.5 Point out reasons nonmechanized recreational activities should be favored over the mechanized recreational implements (canoeing, hiking, cross-country skiing, and snow-shoeing vs. snowmobiles, dune buggies, power boats, trail bikes, and four-wheel drive vehicles).
   - 1.6 Conduct ecology fairs in which exhibitors show objects, drawings, and photographs illustrating local environmental problems. In addition, organize an exhibit showing objects which can be made from recycled materials.
   - 1.7 Use street theater presentations in various neighborhoods to make the public aware of a problem or a situation. These short improvised skits often involve the spectators as actors.
   - 1.8 Devote a regular session of the school newspaper to environmental topics.
   - 1.9 Compile and publish a list of methods that will cut down on household waste and stop pollution.
   - 1.10 Make films or slides which point out good or bad aspects of the visual environment. These could be presented to other students in the school or to PTA groups.
   - 1.11 View professionally prepared audiovisual materials on environmental and conservation problems.
   - 1.12 Conduct special assembly programs during a local environmental education week, possibly featuring an expert on some phase of environmental work.

URBANIZATION

OVERVIEW

Urbanization is the process by which increasingly large numbers of people are concentrated in relatively small areas called cities. Before 1920 the population of the United States was predominantly rural; since that time, shifts in population to the cities have made it predominantly urban. The same pattern of growing urbanization is found throughout the world with the developing nations urbanizing at an even more rapid rate than the developed countries. It is expected that 60 percent of the world's population will live in urban areas by the year 2000, an increase of 35 percent since 1900.

People are attracted to the city by employment opportunities, social and cultural benefits, and accessibility to goods and services. However, as urban populations grow, the natural ecological system is disrupted, "people" space is diminished, and a host of personal and environmental problems is created. If cities are to survive and serve their inhabitants in beneficial ways, new urban planning strategies, involving sound ecological principles, must be created and implemented.

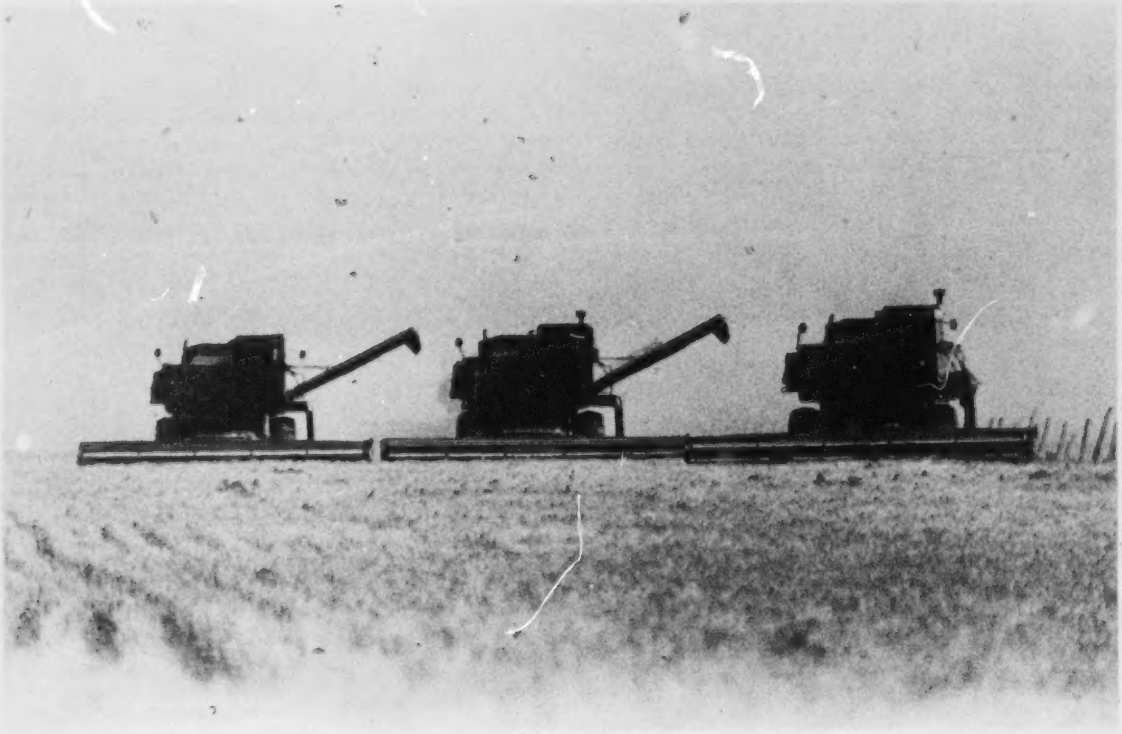
GENERALIZATIONS AND SUGGESTED STUDENT ACTIVITIES

1. **Physical characteristics of the city may determine growth, which has disrupted the natural geography and ecological system.**
   - 1.1 Make films or slides which point out how a city's growth has changed the surroundings.
   - 1.2 Survey the community to determine what new ecology has been superimposed.
2. **Cities were initially established for the survival and well-being of people.**

   Use newspaper articles and interviews in the community to determine how the local geography and resources were involved in the initial establishment of a particular urban center.
3. **Geography and resources were the bases for the original location of urban areas: the character of a city is determined by the environment.**

   Invite an architect, city planner, or designer to visit the school and discuss environmental design.
4. **The character and purpose of a city changes in time with respect to a dynamic interaction of (a) different cultures; (b) economics; (c) the amount, quality, and use of land; and (d) changes in life style.**

   Reconstruct the growth of the community by panorama, maps, photos, or other methods and illustrate how the changes took place.



POPULATION AND ENVIRONMENT

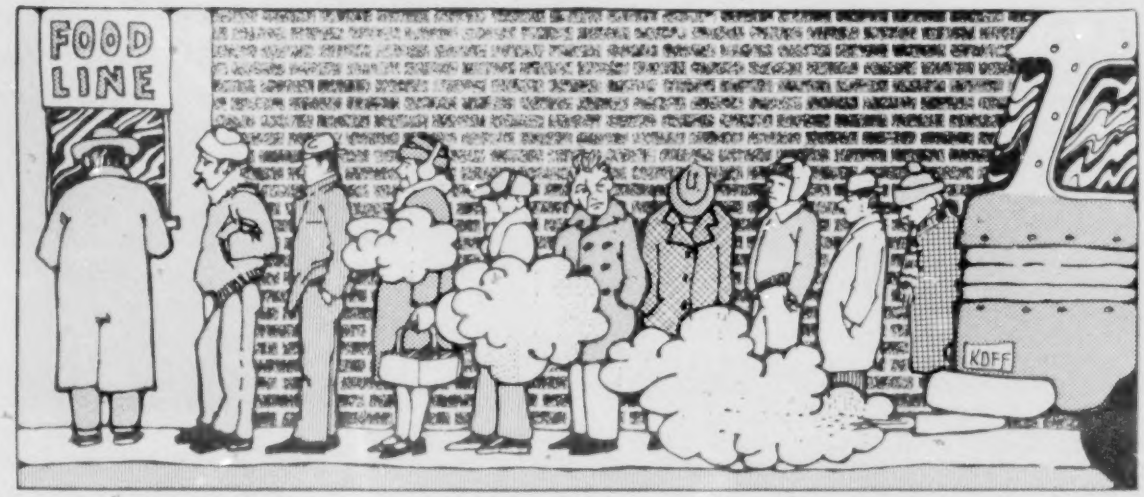
OVERVIEW

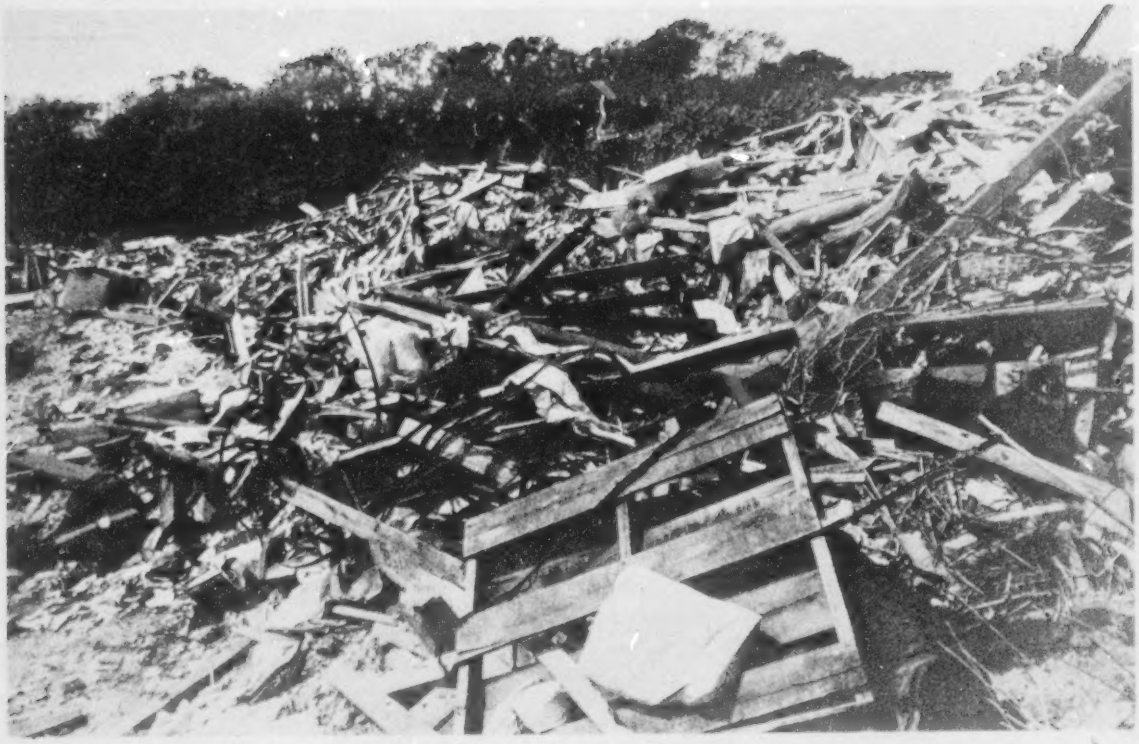
The present rate of population growth, unprecedented in history, has reached the point at which future alternatives for population change must be mapped in order to preserve the existence and quality of life on this planet. The worldwide shortage of food and energy are dramatic reflections of this problem. Pollution of the atmosphere and water is largely the result of industry's effort to satisfy the increasing demand of people for goods and services.

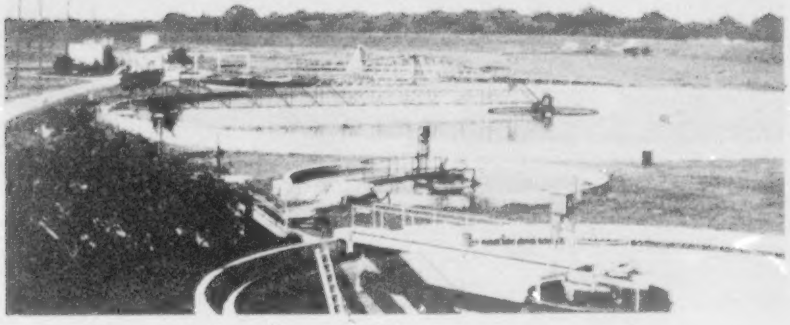
Lasting solutions to these problems of shortage and pollution will not be found until effective procedures are developed to limit population growth.

GENERALIZATIONS AND SUGGESTED STUDENT ACTIVITIES

1. **A knowledge of population trends in the United States and in international communities provides information for understanding past and present population changes.**
   - 1.1 Research and explain what constitutes a demographic trend for both human and non-human species.
   - 1.2 Graph demographic trends throughout the history of the United States.
   - 1.3 Invite community speakers to discuss the need for balance between population growth and economic development.
   - 1.4 Construct illustrations of geometric progressions vs. arithmetic progressions to illustrate the Malthusian principle. Calculate some of the tragic events that could take place if the population increase isn't slowed. (The world population is now doubling approximately every 37 years.)
2. **Human and biological ecosystems reflect population change. Factors producing these changes emerge for social and natural systems on the earth.**
   - 2.1 Experiment with effects of overcrowding, noise, and air pollution on various insects.
   - 2.2 List probable population changes in biological ecosystems caused by food, climate, disease, geography, and habitats.
3. **People should understand the implications of population trends and determine alternative plans for the future. By pooling human resources, people can develop realistic and operational solutions to the population problem.**
   - 3.1 Discuss what effect the increasing urban population will have on the environment by increasing demands for food and fiber while fewer people remain on rural lands to produce farm products.
   - 3.2 Publish a list of methods each student can utilize to cut down on waste and stop pollution in the home. Encourage students to compare the methods listed with their own uses of water, food, and electrictiy.
   - 3.3 Conduct interdisciplinary studies to show that pollution is not restricted to industry, municipalities, the scientific community, or schools and that the solutions to the existing problems have become a matter of everyone's survival.







THE PROBLEMS OF SOLID WASTE AND RECYCLING

OVERVIEW

Solid waste is defined as material which has no use in its present form and location. It accumulates in proportion to the activity of people, the growth of human populations, and the kinds of individual life styles.

Solid waste is moved from points of origin to points of environmental impact by both natural and human transport systems. Decisions regarding the management of solid waste materials are influenced by economics, technology and public concern. Individuals are also able to influence decisions.

To sustain human and natural systems, production, transportation, and utilization of solid waste materials must be managed in ways that are consistent with sound ecological and economic principles.

GENERALIZATIONS AND SUGGESTED STUDENT ACTIVITIES

1. *Solid waste* **is material that has no use in its present form or place.**
   - 1.1 Find out how local waste is disposed of.
   - 1.2 List four solid waste items that are potential resources.
   - 1.3 Obtain films from the Texas Department of Health Resources which show different methods for sewage disposal, water treatment, and garbage disposal. Plan field trips to the city plants and report about reactions and suggestions.
   - 1.4 Contrast the solid waste problems of the United States with those of other countries of the world.
2. **Solid waste originates from the activity of people and is proportional to population growth and current life styles.**
   - 2.1 Write a description of how consumer action and individual responsibility are important to the solid waste management problem.
   - 2.2 Inventory different solid wastes in your home for one day. Bring the inventory to class and classify items.
   - 2.3 Have the community sanitation officer talk about how solid waste problems are proportional to population growth.
   - 2.4 Trace the making of paper or a match to learn how many trees are involved in the manufacture of these products, how much water is used, and how pollution is created by the process. Explain the principle of recycling.
3. **Both natural and human transport systems are used for solid waste.**
   - Trace various solid wastes from source to disposal through natural and human systems.
4. **Individual decisions regarding management of solid waste materials are influenced by economics, technology, and public concerns.**
   - 4.1 Contrast how present life styles and the standards of living increase the solid waste problems. These could include packaging, new processes and materials, and consumer habits, including littering.
   - 4.2 Visit waterways and recreational areas in the community to survey the amount of litter left by humans. Older students might contact local authorities to determine the cost for cleaning the various recreational areas.
   - 4.3 Identify an area that is polluted by litter left by humans. As a group, plan alternative ways of eliminating the litter problem in that area.
   - 4.4 Discuss some problems including cost of recycling waste materials.
   - 4.5 Discuss papermaking and/or lumber manufacture and how industry is reducing manufacturing wastes by recycling.
   - 4.6 List five local career opportunities in the field of solid waste management (waste water treatment, land fill operations, recycling technology, environmental agencies, environmental education.)

RAIL ROAD
CROSSING
2
TRACKS
STOP
ON RED
SIGNAL

SOUND POLLUTION

OVERVIEW

Scientists estimate that the level of sound in the modern world increases at a rate of one decibel every year. Although a level of 80 decibels is considered loud and 120 decibels is dangerously high, some jet engines produce 103 decibels from 1,200 feet, subway cars create 105 decibels for passengers, motorcycles register well over 100 decibels and jackhammers register over 120. Trucks with faulty mufflers can produce as much sound as 100 cars.

What are the consequences of this rising level of sound? It is estimated that three out of five human beings have suffered some hearing impairment and many young people are prematurely deaf. Supersonic sound has been known to shatter windows, weaken foundations of buildings, and influence the health of humans and the productivity of farm animals.

GENERALIZATIONS AND SUGGESTED STUDENT ACTIVITIES

1. **Sound results from vibrations set up in matter; some sounds are disagreeable or harmful.**

   Demonstrate in class that different sounds make one feel sad, happy, angry. Demonstrate how certain sounds are dangerous and can injure the ears. This activity can possibly be conducted with the use of a tape recorder.

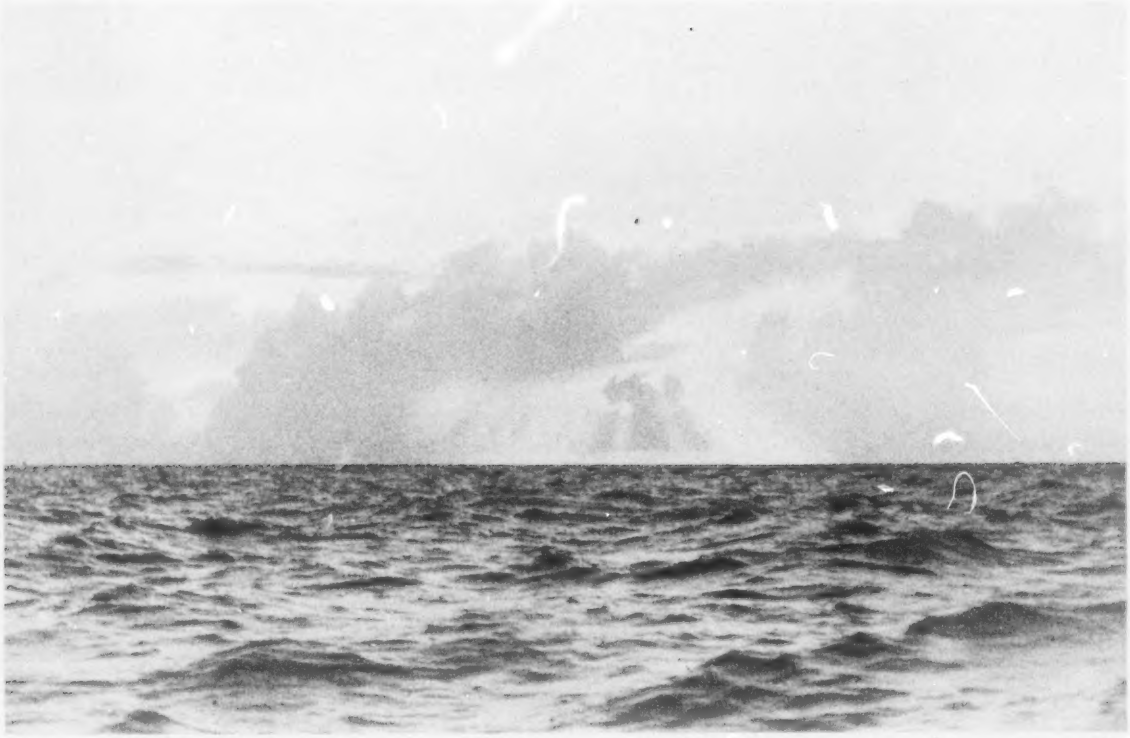
2. **Management of sound involves maintaining a balance in the use of sound for necessary purposes—sirens, unavoidable construction noise—and control of harmful or disagreeable sound.**

   2.1 List five sounds, such as natural sounds, that are unavoidable.

   2.2 Identify three psychological effects of sound (anxiety, insomnia, behavioral changes).

   2.3 Identify three physical effects of sound (hearing loss, nausea, hypertension).

   2.4 List three sources of sound that may produce physical effects (sonic boom, ultrasonics, subsonics).

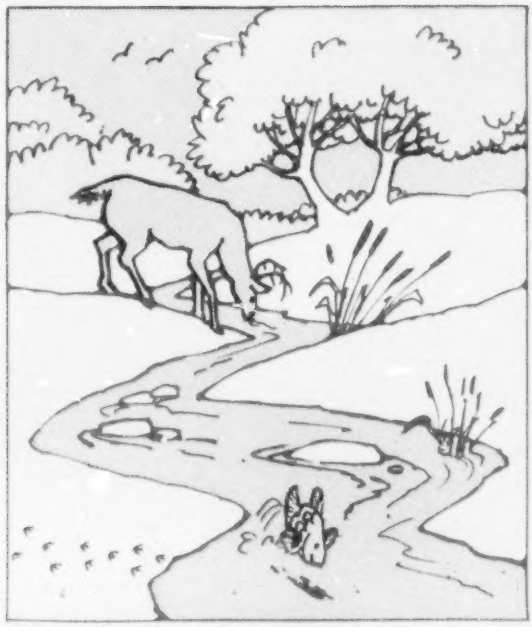


WATER POLLUTION

OVERVIEW

Water is essential to life. Water is a primary resource upon which living things depend. It is the lifeblood of civilization.

People must develop an awareness of factors causing water pollution and depletion. Since the amount of water available for use is limited, abuse of water resources will bring about a catastrophe if left unchecked.



GENERALIZATIONS AND SUGGESTED STUDENT ACTIVITIES

1. **Water is an essential resource.**
   Analyze water uses in agriculture.
   - Water and chemicals (fertilizers, pesticides, herbicides)
   - Organic wastes, feedlots, cattle grazing

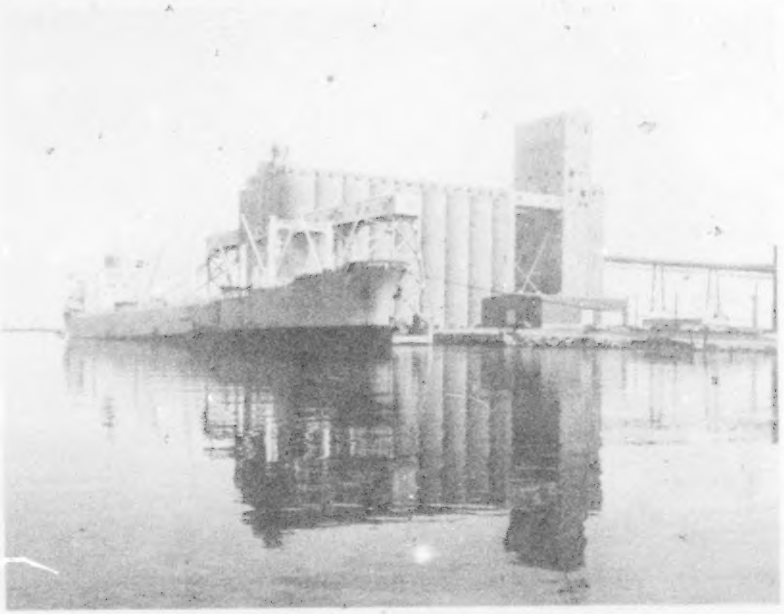
2. **Water is a unique substance.**
   - 2.1 Examine various forms of water—snow, ice, liquid.
   - 2.2 Examine different kinds of water—salt, brackish, fresh.
   - 2.3 Identify the sources of water—atmospheric, surface sources, subsurface sources.

3. **Water has a variety of sources.**
   Study the origins of water on the earth—volcanic, atmospheric.

4. **Water is constantly being recycled.**
   - 4.1 Fully explore the alternatives of reclaiming water, converting sea water, reducing evaporation, and purchasing excessive agricultural water rights such as in the Imperial Valley of California.
   - 4.2 Discuss how nature purifies water. What part do trees play in the cleaning process? What effect will continued pollution have on this natural cleaning process?
   - 4.3 Diagram the hydrologic cycle.

5. **Man uses and alters water.**
   - 5.1 Define *thermal pollution* and describe how it affects life.
   - 5.2 Investigate industrial uses of water, chemical, nuclear, thermal, other means of changing and diverting water.
   - 5.3 Find answers to these questions and discuss: How do nonbiodegradable chemical substances do their damage to ecological balance? What is the basic chemical difference between nonbiodegradable and biodegradable detergents? Do biodegradable substances have a polluting effect on an aquatic environment?
   - 5.4 How much residue from various polluting substances is present in local waters?
   - 5.5 Study and discuss the ocean's economic resources, including military uses, power production, medical uses, and career opportunities.
   - 5.6 Show how minerals are utilized in the school building. Show pictures of minerals being extracted by mining, drilling, dredging, and extraction from sea water. Research abuses of mining techniques in Texas and its coastal waters.

6. **Conservation of water is essential to continued life on earth.**
   - 6.1 Investigate the relationship of the finite supply of water to the increase in population.
   - 6.2 Examine individual responsibility toward water consumption and the need to cooperate with water conservation practices.
   - 6.3 What is the condition of the life found in local ponds? Investigate one or more local ponds. Find out whatever you can about any green plants growing in the water. Dip out water samples with a strainer; study microscopically any animals found there. Are there signs that the pond is dying as a result of overfertilization of nearby fields?



FOOD POLLUTION

OVERVIEW

Ingenious and revolutionary changes have occurred in methods of mass producing, transporting, storing, packaging, and marketing food for modern civilization. However, inherent in these changes are dangers and threats to people's health and survival. Hormones, antibiotics, dyes, flavorings, and preservatives have been added to food; remnants of fungicides and pesticides are found in agricultural products; wastes, poisons, and refuse are sometimes included in large-scale food production.

Furthermore, ignorance of basic food and nutritional requirements has made people victims of exploitation and profiteering by advocates of food fads and overuse of vitamins. As a consequence, the human diet is often not only inadequate but harmful.

GENERALIZATIONS AND SUGGESTED STUDENT ACTIVITIES

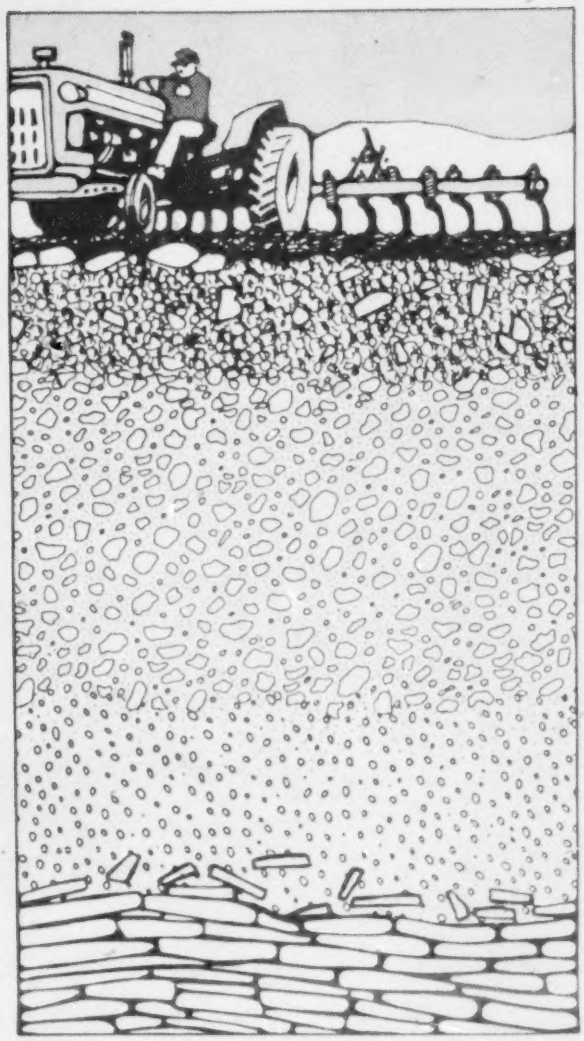
1. **The composition of food is modified to enhance its quality, quantity, and convenience of preparation.**
   - 1.1 List foods with different additives and tell what the additives accomplish.
   - 1.2 Describe how economic factors (convenience, transport, food appeal) account for some additives in food.
   - 1.3 Describe and give examples of how food processing practices result in additions such as tenderizers, coloring agents, texturizers, hydroscopic agents, flavor enhancers, odor modifiers, vitamins, and minerals.
2. **Certain food or feed additives may constitute an immediate or long-range health hazard for organisms.**
   - 2.1 Trace the influence of a food or feed additive on the organisms involved in a food chain.
   - 2.2 Describe and give examples of how unsanitary food preparation practices result in addition to food.
   - 2.3 Describe and give examples of how food preparation practices result in deletion of food components, including minerals and vitamins.
3. **The individual must work cooperatively with other persons and agencies to ensure the proper production and distribution of food.**
   - 3.1 Describe how consumer demands account at least partially for the presence of food pollutants.
   - 3.2 Identify four sources of nonnatural contamination of sea and shell life.
   - 3.3 Identify three sources of natural contamination of food.

SOIL POLLUTION

OVERVIEW

Although the soil is merely a thin film that covers a small part of the earth's surface, it is essential to life. The soil has many uses; it is the medium and the participant in essential ecological processes.

The cultural, social, and economic development of different regions are related to the variations in soil from locale to locale. The future of all life is dependent on the wise management of the soil both locally and internationally. The population increase makes it even more imperative that an intelligent environmental ethic regarding soil be developed.



GENERALIZATIONS AND SUGGESTED STUDENT ACTIVITIES

1. **Soil is the result of chemical, physical, and biological changes. Some are natural; others are caused by people.**

   Check the drainage problems after a heavy storm, or locate storm sewers and monitor their efficiency.

2. **The physical composition of soil varies, in stratification and water-holding capacity.**

   Collect samples of four soil types. Compare the soils in color, particle size, and water-holding capacity.

3. **Soil varies in its organic and inorganic composition.**

   Collect samples of four soil types. Examine the soil for vegetable matter (pieces of plants). Determine the amount of humus in each type of soil.

4. **The soil can be managed in both positive and negative ways, such as cultivation, irrigation, mining, industrial landfill, and construction.**

   4.1 Study soil erosion, its causes and prevention. Show how some changes in the environment are caused by carelessness and thoughtlessness (removal of soil cover, floods, bad farm practices, and lack of plants).

   4.2 Prepare a paper showing means of stopping erosion.

   4.3 Take a field trip for the purpose of observing and investigating plant communities. The trip could begin in the school yard and extend to fields, woods, ponds, and boggy areas. Note the differing plants in different locations.

   4.4 Set up a classroom aquarium, following directions for making a balanced aquarium. Also set up a terrarium.

   4.5 Participate in beautification and vegetable gardening projects on the school campus.

   4.6 Map the watershed immediately surrounding the school area and determine whether water is being used properly or abused.

5. **Effective soil management in the future will require a soil conservation ethic which will govern management practices.**

   5.1 Research and discuss present land use laws which help preserve the soil.

   5.2 Research shelterbelts and windbreak plantings. How do these correct past ecological mistakes?

ATMOSPHERIC
MONITORING STATION
TEXAS AIR CONTROL BOARD

AIR POLLUTION

OVERVIEW

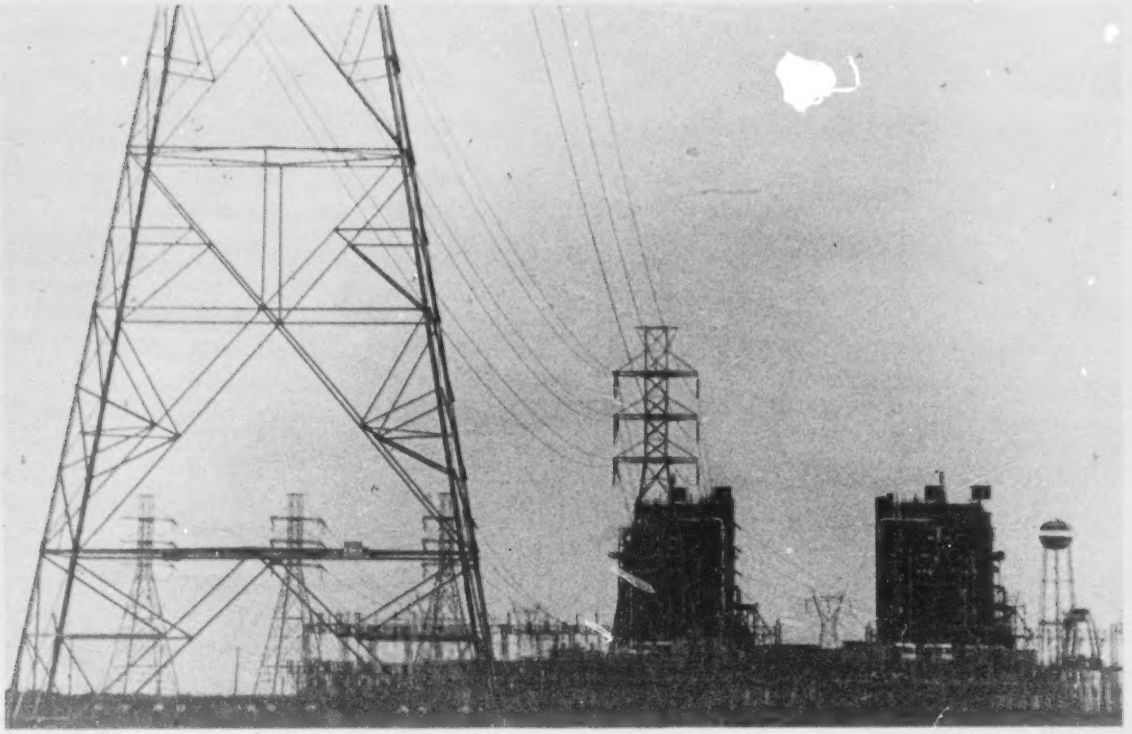
The air we breathe today is a mixture of various gases as well as some solids and liquids. These gases, essential to all life, have resulted from evolutionary changes over billions of years. These modifications, which continue today, have produced air pollution levels which may be affecting and accelerating the evolution of various species. Since all life is dependent on one of more of the air's constituent gases for survival, it is the common property of all living organisms. Air pollution is of vital concern to all because of the differing tolerance levels of various life forms.

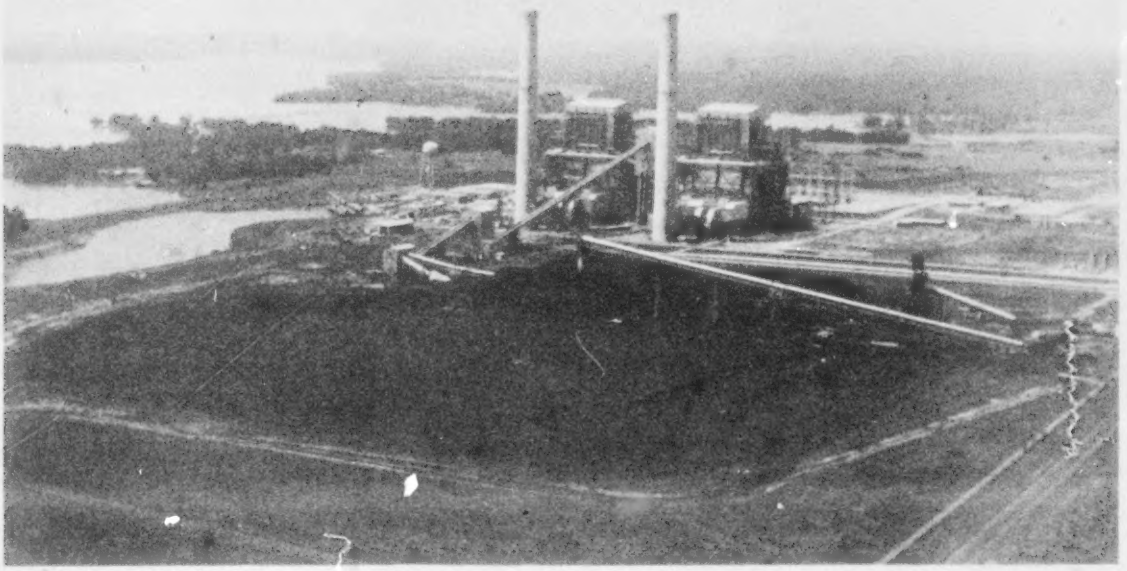
The eventual survival of species is threatened by various possible air-related catastrophes: (1) Disappearance of the oceanic plankton, which produces 70-80 percent of the earth's oxygen; (2) reduction of the quality of life, as related to aesthetics, recreation, and mobility; (3) health problems in humans, especially emphysema and respiratory diseases.

Local, regional, and national air pollution problems are inter-related. There is also a continuing interdependence of air pollution on water and land pollution. Natural, geographic, and man-made environmental conditions also modify the patterns of air pollution.

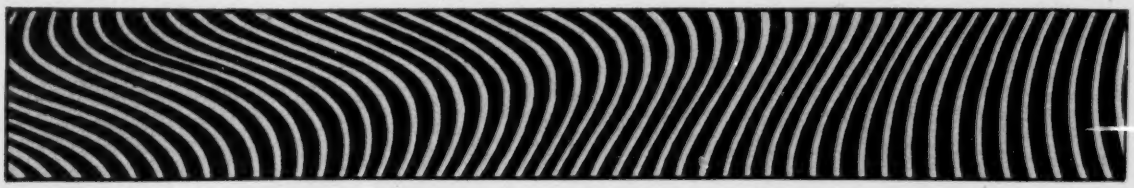
GENERALIZATIONS AND SUGGESTED STUDENT ACTIVITIES

1. **Air is essential for most living things.**
   Observe respiratory mechanisms in plant and animal forms through experimentation, field observations, and experience.
2. **Properties of polluted air are affecting the health and well-being of plants and animals, as well as non-living things which share this planet earth.**
   - 2.1 Relate current interest in electric-and steam-powered automobiles to this problem.
   - 2.2 Report on automobile smog equipment. Report on new types of auto power.
   - 2.3 Research news articles related to the effects of smoking cigarettes and cigars.
   - 2.4 Assign reports on the respiratory conditions associated with smog; such as emphysema and miners' asthma.
   - 2.5 Write reports on several of the serious smog incidents: London, 1952; Donora, Pa., 1948.
   - 2.6 Demonstrate limitations on sensory perception caused by pollution in the atomosphere.
   - 2.7 Examine the long-term effects of pollutants on human beings.
   - 2.8 Make a diagram of the atmosphere under normal conditions and during a temperature inversion.
3. **The aesthetic quality of community life can be adversely affected by air pollutants.**
   - 3.1 Take a field trip to an air monitoring station in your area to observe equipment for measuring pollution levels.
   - 3.2 Make a study of the effects smog is having on food and tree production (vegetation) and human health in one or more of the densely populated areas of our country.
   - 3.3 On a walking tour of the area near school, look for evidence of damage by air pollution.
   - 3.4 From your observations, discuss the presence or absence of smog in the city nearest you. Observe a daily map which indicates the degree of pollution.
   - 3.5 Discuss how air pollution affects beauty and comfort of the environment.





THE ENERGY CRISIS AND DEPLETION OF NATURAL RESOURCES



OVERVIEW

Increased world population has raised the consumption levels of energy and natural resources to an alarming level. People tend to use more modern conveniences, which use more energy. Research and applied technology have not yet discovered solutions to this environmental crisis.

If mankind is to cope with this crisis, it is essential that people understand the basic principles of the interactions of matter and energy. In addition, they should critically examine the use and abuse of energy and natural resources in the past and present.

GENERALIZATIONS AND SUGGESTED STUDENT ACTIVITIES

1. **Energy is found in several forms. The form of energy can change, but some energy is lost in the process.**
   - 1.1 Contrast various methods of electric power generation.
   - 1.2 Use local resources to examine the following factors which are currently influencing supplies of natural resources: land scars, loss of open space, oil slicks, radiation, thermal pollution, blackouts, waste disposal problems.
2. **Solar energy is the earth's major source of energy. It is absorbed and used by plants to manufacture foods; it provides energy in the form of heat and can be converted directly into electrical energy.**
   - 2.1 Make a survey of recently installed solar energy devices in the community.
   - 2.2 What energy devices require present-day technology is capable of converting the sun's energy into useful energy?
   - 2.3 Build or put together solar energy kits using solar conversion cells obtained from local hobby or radio shops.
   - 2.4 Write a paper describing recent developments in reflector technology as related to the conversion of solar energy into useful energy.
3. **Demand is increasing for resources that are limited.**
   - 3.1 Make an inventory of natural resources by studying sources, depletion rates, limits, and distribution.
   - 3.2 Organize a resource information bank in the library. One group could gather data concerning the resources and their supply. The data could be put into a portable file case located in the school library. This file cabinet could be kept current by continuously adding information. This information bank would be available to the whole student body and faculty.
4. **Solutions to the energy crisis will require new technology, change in life styles, and both short- and long-range planning.**
   - 4.1 Compare the amounts of energy necessary to manufacture or produce equal quantities of several different basic materials such as wood, steel, aluminum, and plastic.
   - 4.2 Prepare a list of electrical appliances found in most homes and list possible nonelectric alternatives.
   - 4.3 Collect newspaper articles reflecting a change in energy sources.
   - 4.4 List six things students can do in changing life styles, attitudes, values, beliefs, and behavior that will help solve the energy problem.
   - 4.5 List five technological advances that will contribute to the solution of the crisis, including new energy sources, alternative resources, recycling, and more efficient machines.
   - 4.6 Prepare a report illustrating how homes could be changed to reduce energy consumption (for example, use of glass, insulation, and location).
   - 4.7 Conduct a contest on how to conserve energy. Issue each student one ice cube. The student can treat the ice cube as desired; however, the object is to keep the cube from melting. The student whose cube is the last to melt wins.

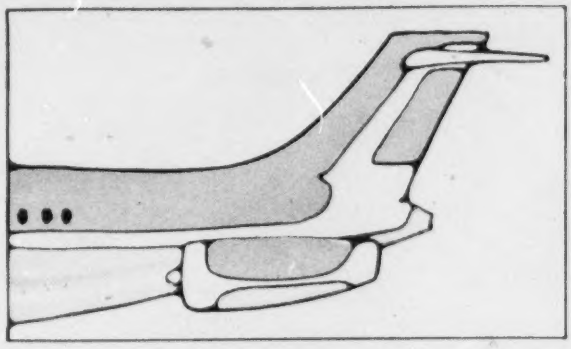
DRUG STORE

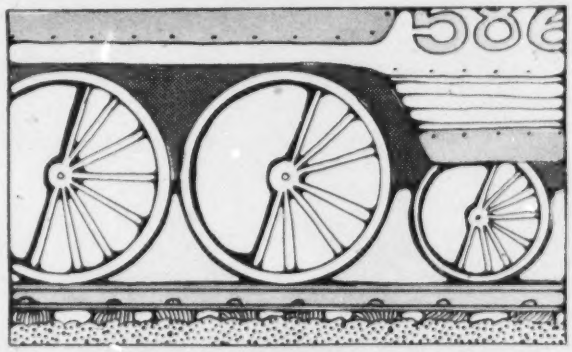
TRANSPORTATION AND THE ENVIRONMENT

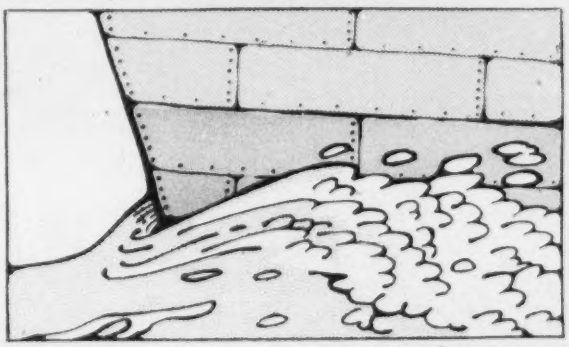
OVERVIEW

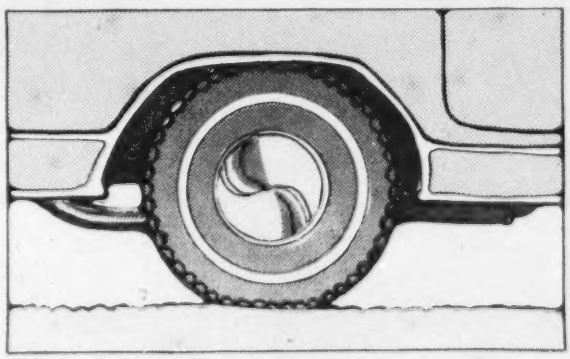
Transportation has helped transform American society from rural, agrarian to urban, industrialized. Various kinds of transportation have been involved in this process and have had varying effects on the environment. The choice of transportation has produced certain stresses on environmental systems.

It is important for citizens to know how transportation systems are planned and to participate actively in the planning process. They should know how different transportation systems affect their communities and individual life styles.



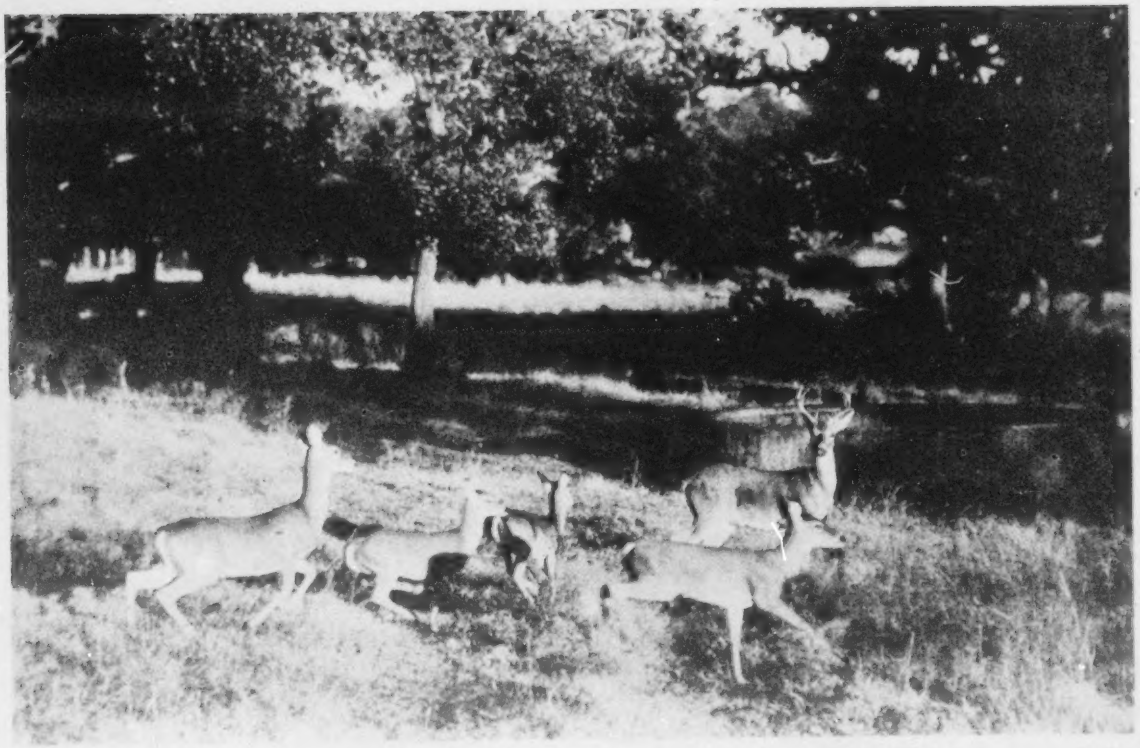


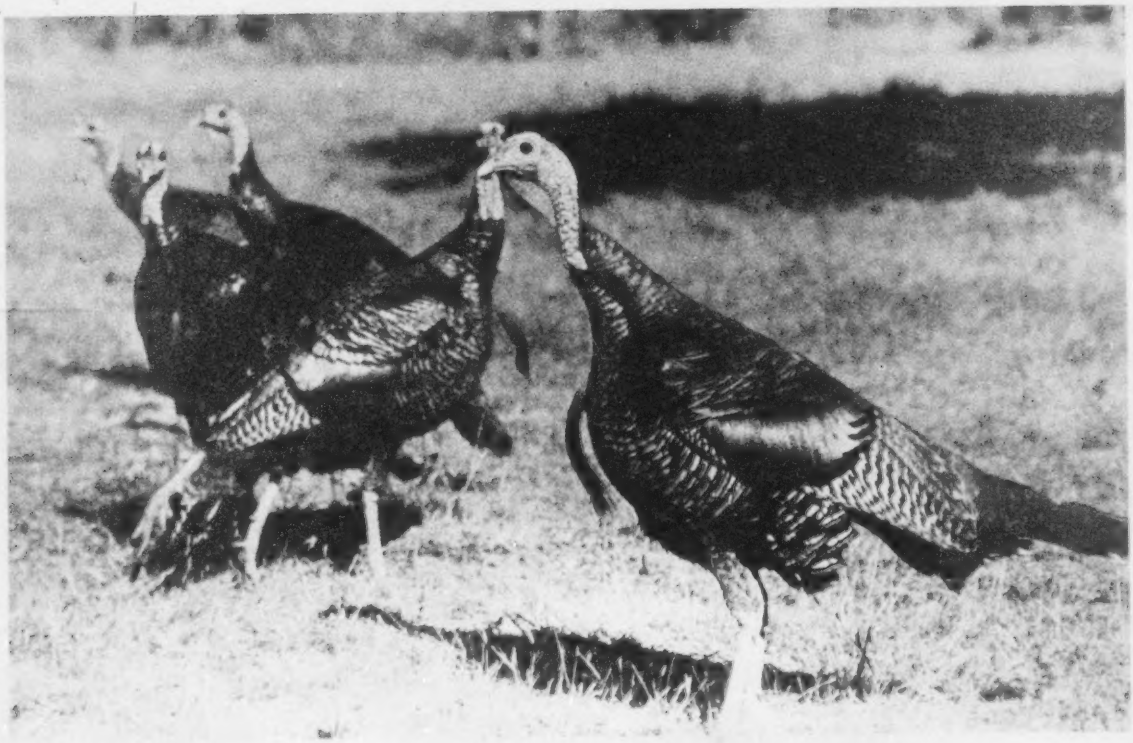




GENERALIZATIONS AND SUGGESTED STUDENT ACTIVITIES

1. **Transportation is essential to the fulfillment of basic needs for food, clothing, and shelter and has a major effect on life styles.**
   - 1.1 Identify the ways in which transportation in your community helps to satisfy basic needs for food, clothing, and shelter.
   - 1.2 Use periodicals and other resources to illustrate how beef is transported from Argentina to Texas.
   - 1.3 Write a description of how a shirt, or similar item, is transported from Taiwan to stores in your area.
   - 1.4 Describe how oil is transported from the Middle East to your community. Discuss how a reduction in oil imports affects each person.
2. **Transportation has a major effect on land use planning.**
   - 2.1 Plan an alternative transportation system to solve an existing problem in the local community.
   - 2.2 Compare the land requirements and cost required by differing modes of transportation, such as plane, train, bus, or car.
3. **All modes of transportation have direct effects on natural resources.**
   - 3.1 Determine the effects of relocating or constructing new transportation facilities in your area.
   - 3.2 List reasons to use public transportation facilities in lieu of private vehicles. List reasons some people consider private vehicles more desirable than public transportation.





WILDLIFE

OVERVIEW

Wildlife is a precious resource because, once a species is extinct, it cannot be recreated by any means presently available. Protection of wildlife is important for a variety of reasons, both aesthetic and ethical.

Efforts to conserve wildlife should not be concentrated merely on species and habitats but should look also to those human activities which affect the preservation of species.

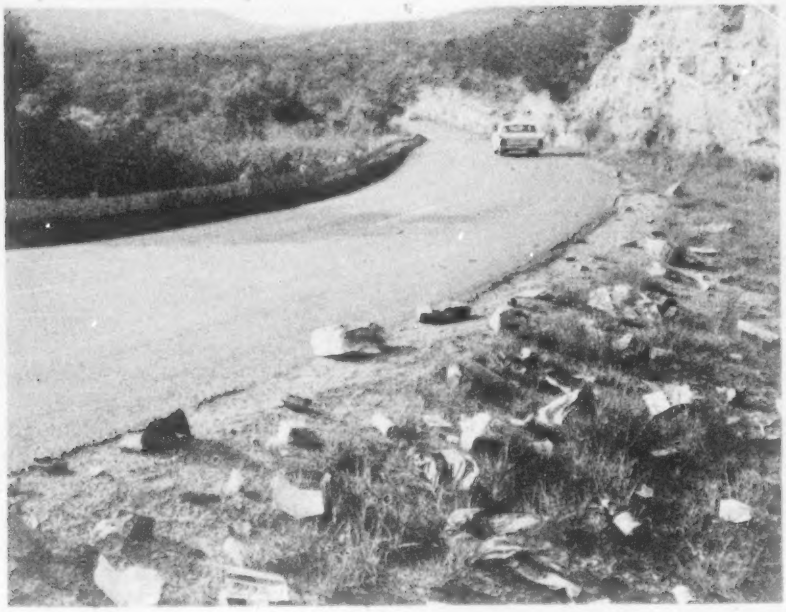
Population growth and increased technology throughout the world are threatening wildlife on a global scale. Wildlife management, therefore, should be presented to students so that they will have a realistic and balanced view of the current situation.

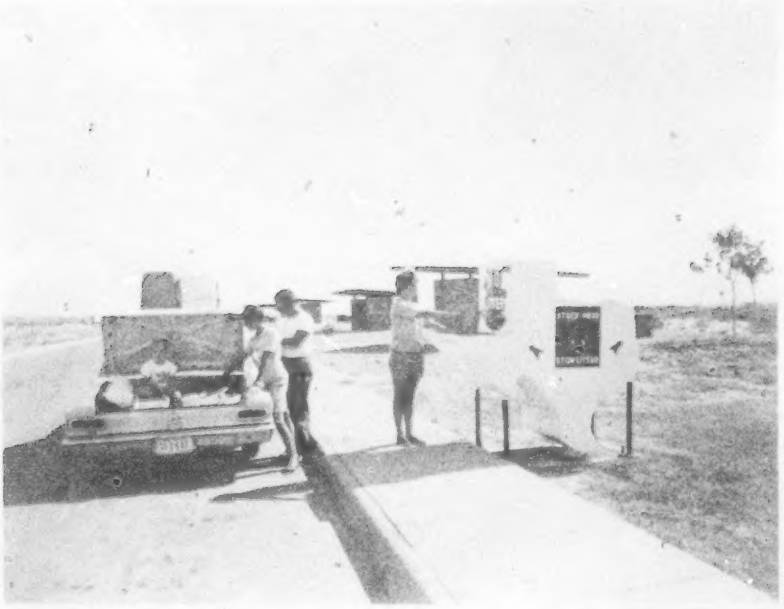
GENERALIZATIONS AND SUGGESTED STUDENT ACTIVITIES

1. **Wildlife species deserve protection from extinction, for aesthetic and ethical reasons.**
   - 1.1 Find animals in nature that are decreasing in number, and those that are increasing. Show where people are responsible for these changes.
   - 1.2 Coordinate educational programs and planned projects that will take place during a local environmental education week.
2. **Human endeavors are related to the survival of wildlife species.**
   - 2.1 View a film on wildlife or visit a museum or animal refuge.
   - 2.2 List advantages of using live trees native to your area at Christmas.
3. **An affluent society's mobility, land use, and power needs infringe on and destroy wildlife and its habitats.**

   Have experts in soil conservation, wildlife management, water quality, air quality, and agricultural production on a panel to discuss how the problems are interwoven and yet unique.
4. **Wildlife has sometimes been mismanaged or exterminated because people were threatened by nature or they miscalculated the abundance of life.**

   Discuss changing attitudes toward wilderness. Once it was something to be defeated or tamed; now its remnants are becoming something to be cherished. What effect will creation of more wilderness have on reducing the amount of land needed for food and fiber?
5. **People must assume the responsibility for the continued existence and balance of all species.**
   - 5.1 Compare elimination of predation and consequent overpopulation of animal species (such as deer) with health advances followed by overpopulation of human species. Investigate other examples of natural balance (perhaps with field trips).
   - 5.2 Conduct interdisciplinary studies to show that pollution is not restricted to industry, municipalities, the scientific community, or schools, and that the solutions to the existing problems have become a matter of survival.





WHAT INDIVIDUALS CAN DO

OVERVIEW

Learning about the environment should be an active process in which students participate in the solution of specific environmental problems related to the resolution of the global environmental dilemma.

This approach is recommended for two reasons: First, research shows that the inquiry method is a superior learning technique and, second, critical environmental problems lend themselves easily to this approach. However, student involvement should be responsible and intelligent and should lead to sensitivity about the environment, individual growth, self-esteem, and commitment.

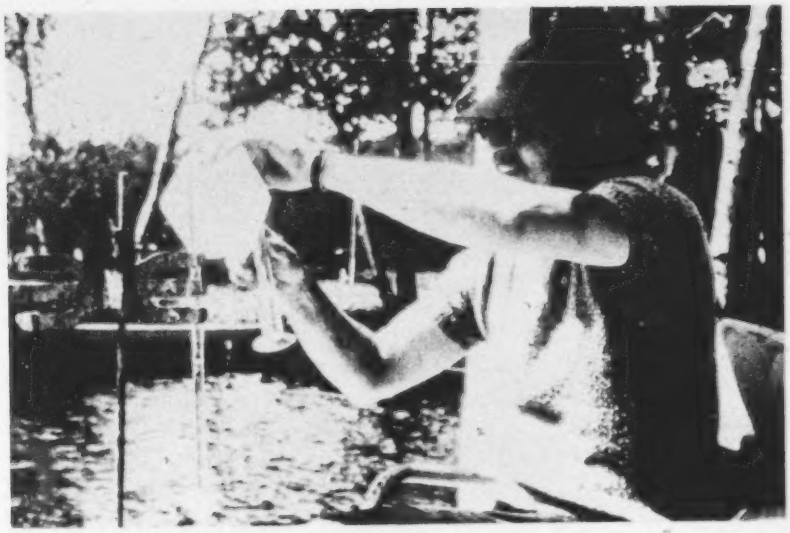
Such a learning process not only facilitates students' current learning, but provides a model for future study and action by both individuals and members of voluntary citizen groups.

Individuals must become informed about environmental problems, accept responsibility for the quality of the environment, become involved in individual and group programs to improve the environment, and develop a sensitivity to the world.

GENERALIZATIONS AND SUGGESTED STUDENT ACTIVITIES

1. **Individuals should become informed about the environment. This is a process of identifying problems, gathering data, and synthesizing information. Underlying this concept are the presuppositions that every individual is a member of many ecosystems and that the aesthetic quality of life is good.**
   - 1.1 Invite resource speakers who are knowledgeable of the problems in the community and who are able to present possible solutions.
   - 1.2 Visit sewage disposal plants and see how they work.
2. **Individuals should be involved. Involvement is contingent upon a person's being informed and responsible. The person who wants to be involved should develop a positive self-image, remain flexible to change, be open to interdisciplinary learning approaches, and recognize that group involvement and cooperative effort are good and necessary in today's world.**
   - 2.1 Prepare a compost heap of grass, garden clippings, and biodegradable garbage. Use this instead of fertilizers for growing plants.
   - 2.2 Write congressmen or legislators about concern for environmental decay.
3. **Individuals should be responsible. The responsible person is one who acts from rational motives, chooses a responsible life style, is open to continuous evaluation and feedback, and chooses educational, occupational, and life goals wisely.**

   Make some written or spoken expression of personal involvement and responsibility—"What I can do about. . . ." Do not limit value judgments on environmental problems to "good guy–bad guy" interpretations, but attempt to understand and discuss reflectively the consequences of such judgment. (For example, if we close the factory because it pollutes the river, what happens to the workers? Or, if we spend a great deal more money for sewage treatment plants, what happens to money for education? Such questions are not efforts to divert attention from environmental problems. They are likely, instead, to help us see these problems in their full scope and difficulty.)



LAND DEVELOPMENT AND LAND USE PLANNING

OVERVIEW

A student must study and become involved in land use planning to understand environmental interaction and to realize that such planning will lead at best to minimal infringement on other living things. Such planning must recognize a hierarchy in living organisms, from humans to fauna and flora, and must involve all life forms if maximum success, as defined by sound ecological principles, is to be achieved.

Environmental problems imposed by people can be resolved by people. Similarly, natural factors affecting human survival can be partially resolved by people, with limited success and possible negative consequences to the environment.

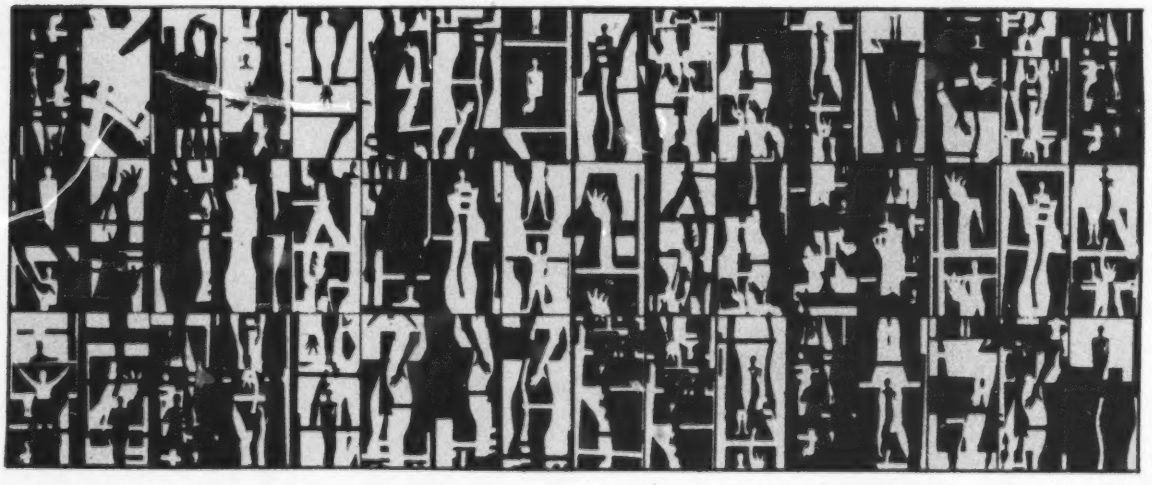
Furthermore, people must realize that for successful operation in the biosphere all organisms require ample energy and reserves of resources; they also require ample space to satisfy niche-habitat requirements and compatabilities.

GENERALIZATIONS AND SUGGESTED STUDENT ACTIVITIES

1. **Students should be involved in land development and land-use planning activities.**
   - 1.1 Obtain a data base on the geography of the area in terms of (a) number of streets serving particular buildings and dwellings; and (b) communication needs, such as telephone, transportation, visual.
   - 1.2 Collect photos of people-imposed environmental factors such as housing, production of goods and services (mining, recovery of natural resources, industry, agriculture), and recreation facilities available.
2. **As people use and develop land, their activities infringe on the freedom of other living things.**

   Carry out experiments such as the following with small communities in the laboratory and in the field to verify the ecological principles involved:
   - Make a bio-assay on fish relative to water quality.
   - Make a bio-assay with plants relative to air, land, and water quality.
   - Save insects in a terrarium to determine effects of space and food on a limited population.
3. **Environmental factors imposed by people can best be resolved by people; similarly, environmental factors imposed by nature, as they affect human survival, can be resolved by people with only limited success and possible negative consequences to the environment.**

   Make sketches and models of the following:
   - Use of vacant city property
   - Redesign of street furniture, street signs, trash containers
   - Rehabilitation of deteriorating parks and playgrounds



THE ECONOMICS OF ENVIRONMENTAL PROBLEMS AND SOLUTIONS

OVERVIEW

This unit presents information and experiences to enable the student to understand that environmental degradation or its restoration is directly related to the pocketbook. Fundamental to this unit are the two basic laws of ecology of Barry Commoner: (1) Everything is connected to everything else; and (2) there is no such thing as a "free lunch"—in the world of nature just as in the world of people.

Here, students are exposed to what might be called the money ecosystem, whose first principle is "money talks," or to the history of "cowboy economy" which is characterized by the exploitation of resources, or to the growing conflicts between private rights and public goods.

The teacher should discuss the inherent flaws of an economic system that fails to recognize the hidden costs of producing a product, the effects of altered growth rates in population and gross national product on American life, and the environmental impact of foreign economic and social systems. The next consideration is the relationship between economics and environmental improvements.

After an examination of the advantages and disadvantages of the profit system, it should be stressed that there will be no easy, free solutions, but only choices or trade-offs which will be difficult and expensive, at least in the initial stages.

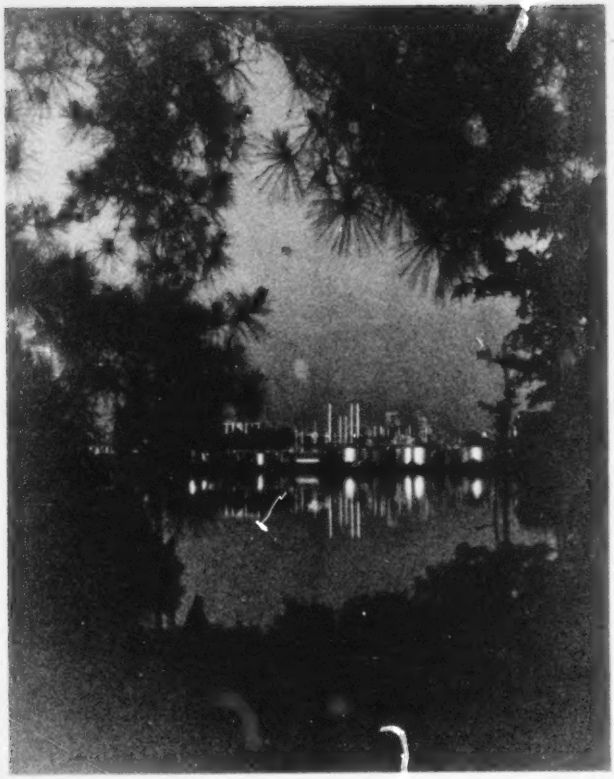
It should be noted that a country as affluent as the United States can afford environmental quality if its people want it. Means must be found to generate as much wealth from environmental improvements as from environmental exploitation.

Do citizens really want to pay the cost of a good environment? Considering ecological principles, engineering capabilities, aesthetic reality, and economic resources, what is the best way to pay for a good environment?

Students should leave this unit with two basic understandings: (1) The American environment and the American economy are interrelated; (2) A student, as an individual and as a member of society, is in a position to make changes which will reverse present environmental trends.

GENERALIZATIONS AND SUGGESTED STUDENT ACTIVITIES

1. **Economics and the environment are interrelated.**
   - 1.1 Investigate the following:
     - Successful (profitable) and unsuccessful (unprofitable) recycling programs
     - Monetary incentives and penalties for stabilizing populations
     - Monetary incentives and penalties for pollution abatement
   - 1.2 Form a discussion group and determine four effects of a population increase on the economy and environment.
2. **Students as individuals and as members of society can influence changes that will reverse present environmental trends.**
   - 2.1 List ways that you can alter your life style in order to improve and preserve the environment.
   - 2.2 List ways in which you could work with various groups and organizations in an effect to improve and preserve the environment.



TECHNOLOGY: SERVANT OR MASTER

OVERVIEW

Technology is understood as applied science dealing with inventions and innovations rather than basic research. In this unit, students will attempt to assess the impact of technology on the dynamics and balance of the earth's various life support systems to determine whether technology is or will become a servant or master for people.

Opinions regarding technology and its relation to the environment vary. Some maintain that technology is neutral but its use has moral and environmental implications. Others argue that modern technology is so powerful it causes a technological intermission which not only stops history but affects human value and belief systems and behavior patterns.

Two extreme positions on the issue can be identified: (1) that technology can resolve all environmental and societal problems; and (2) that technology should be rejected completely in an attempt to return to a lost Arcadia.

A more moderate position is taken by Rene Dubos and Lewis Mumford who argue for a humane technology tailored to human needs. They advocate the use of advanced technology to modify and enhance the environment so that it will remain in productive harmony with the best interests of people.

GENERALIZATIONS AND SUGGESTED STUDENT ACTIVITIES

1. **People must develop a clear understanding of the relationship of technology to the total environment. That understanding must be based on past, present, and projected experience.**
   - 1.1 List three examples of how life styles have been affected by technology and how technology has affected life styles.
   - 1.2 Collect photographs that exemplify ways technology has contributed to political science, humanities, and the arts.
   - 1.3 Trace important historical events and trends in the development and use of technology.
   - 1.4 Contrast life styles of developed countries with those of underdeveloped countries.
   - 1.5 Discuss historical influences on technology.
2. **Technology has both potentially good and dangerous aspects. As long as people govern technology judiciously, it will serve rather than enslave.**
   - 2.1 List seven examples of how technology has made life easier.
   - 2.2 Read current literature to collect data to discuss possible situations in which technology might be the servant of one group of people and the master of another at the same time.
   - 2.3 Through discussion illustrate that at any given moment no one can predict the effect of technology in the future.
   - 2.4 Show that acquisitiveness and too much faith in technology may reinforce each other.
3. **At the core of a healthy technological society is the responsible individual who both initiates individual programs and cooperates with others in collaborative efforts.**
   - 3.1 Suggest alternatives to technology to accomplish tasks in daily lives.
   - 3.2 Develop case studies of past predictive documents which have been proved false by changing technology. Do this for both an unduly optimistic and an unduly pessimistic document.
   - 3.3 Contrast the life style of a low-technology society which does or did enjoy leisure with a high-technology society. Show that technology may, in some instances, eliminate leisure.

ENVIRONMENT: GOVERNMENT, LAW, AND SOCIAL ASPECTS

OVERVIEW

Just as there is a natural or biophysical aspect of the environmental ecosystem, so there is a human or politico-social aspect, each affecting and being affected by the other.

The American political process is vitally involved with environmental concerns, including interpretation of the development of social concepts, the problem situations that selected actions were intended to meet, and the reasons we chose these rather than alternative solutions.

Citizens must deal with environmental problems today through the formal executive, legislative, and judicial departments of government at all levels; the conflict-oriented phases of political processes; and through a variety of voluntary ecoaction organizations.

In this unit, students, are introduced to political and social strategies for influencing public opinion and governmental decisions regarding the environment.

GENERALIZATION AND SUGGESTED STUDENT ACTIVITIES

1. **People can learn to manipulate, control, and effect change within the political arena.**
   - 1.1 Invite guest speakers to discuss the following topics:
     - Local, state, and federal laws on environmental controls
     - Legal, human, and environmental resources
     - Areas requiring development of new environmental legislation and public attention
   - 1.2 Write agencies listed below and determine their roles in conservation:

Bureau of Economic Geology
The University of Texas at Austin
Box X
Austin, Texas 78712

Texas Air Control Board
8520 Shoal Creek Boulevard
Austin, Texas 78758

Texas Mid-Continent Oil & Gas Association
1341 W. Mockingbird Lane
Suite 1111-E
Dallas, Texas 75247

*Texas State Soil & Water Conservation Board
1018 First National Bank Bldg.
Temple, Texas 76501

Texas Education Agency
201 East 11th Street
Austin, Texas 78701

Texas Forest Service
Texas A&M University
College Station, Texas 77843

Texas Parks and Wildlife Department
100 John H. Reagan Building
Austin, Texas 78701

**Texas Department of Health Resources
1100 West 49th Street
Austin, Texas 78756

Texas Water Development Board
P.O. Box 13087
Capitol Station
Austin, Texas 78711

Texas Water Quality Board
P.O. Box 13246
Capitol Station
Austin, Texas 78711

The Railroad Commission of Texas
Ernest O. Thompson Building
10th and Colorado
Austin, Texas 78701

U.S. Geological Survey
306 East Eighth Street
Austin, Texas 78701

U.S. Soil Conservation Service
First National Bank Building
Temple, Texas 76501

*Write to this address for information concerning local Soil and Water Conservation Districts. For free educational materials regarding soil and water conservation, write to Davis Conservation Library, P.O. Box 855, League City, Texas 77573.

**Write to this address for information concerning solid waste disposal.